EDITION B

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INSTITUTION OF PRODUCTION ENGINEERS

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JULY, 1943

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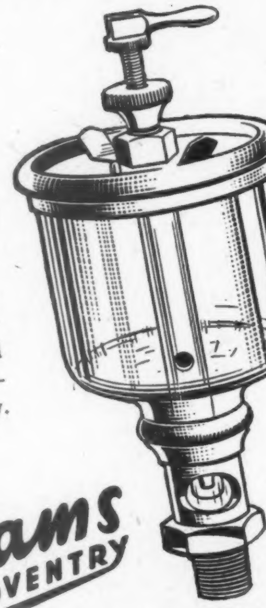

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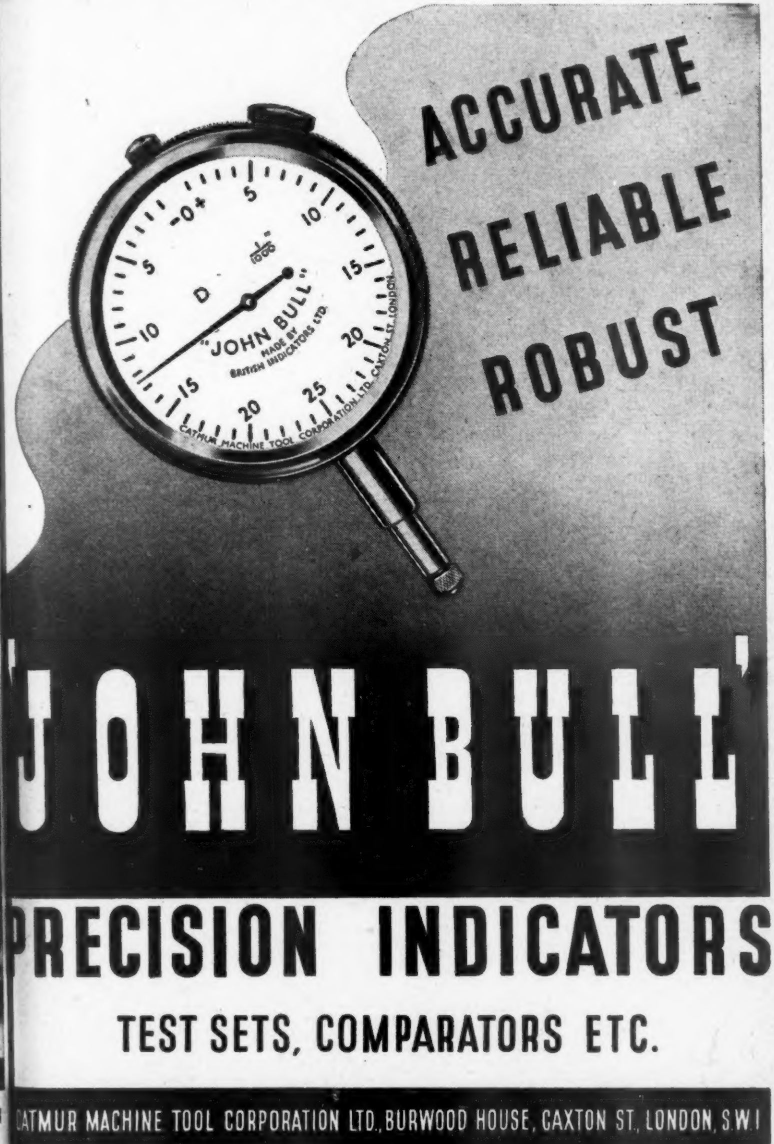
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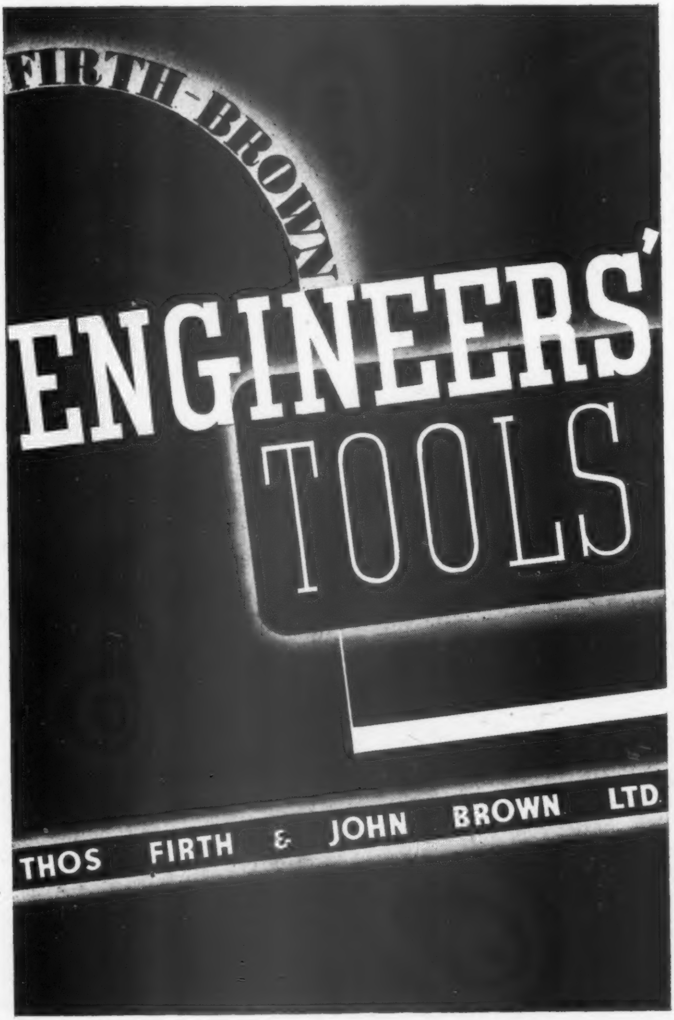
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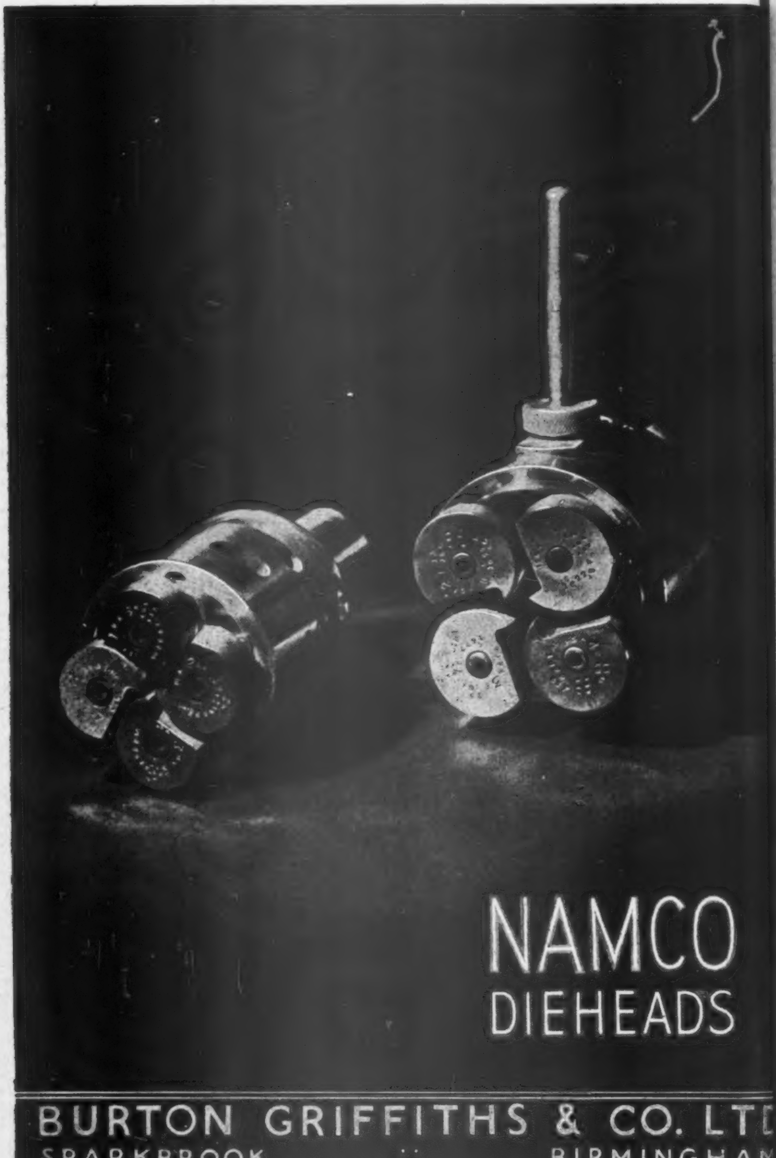
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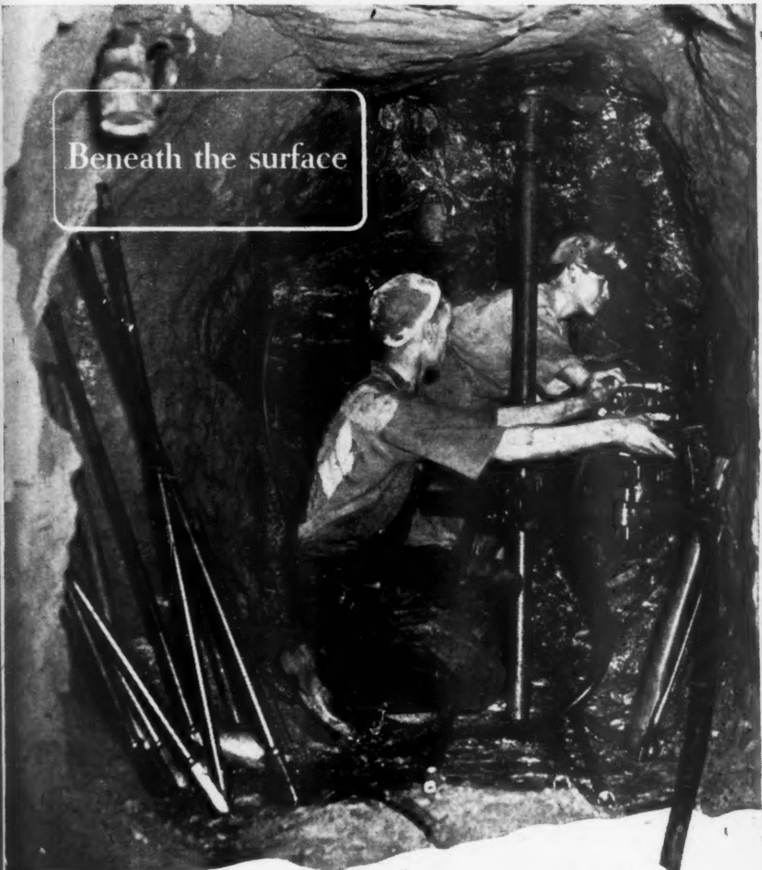
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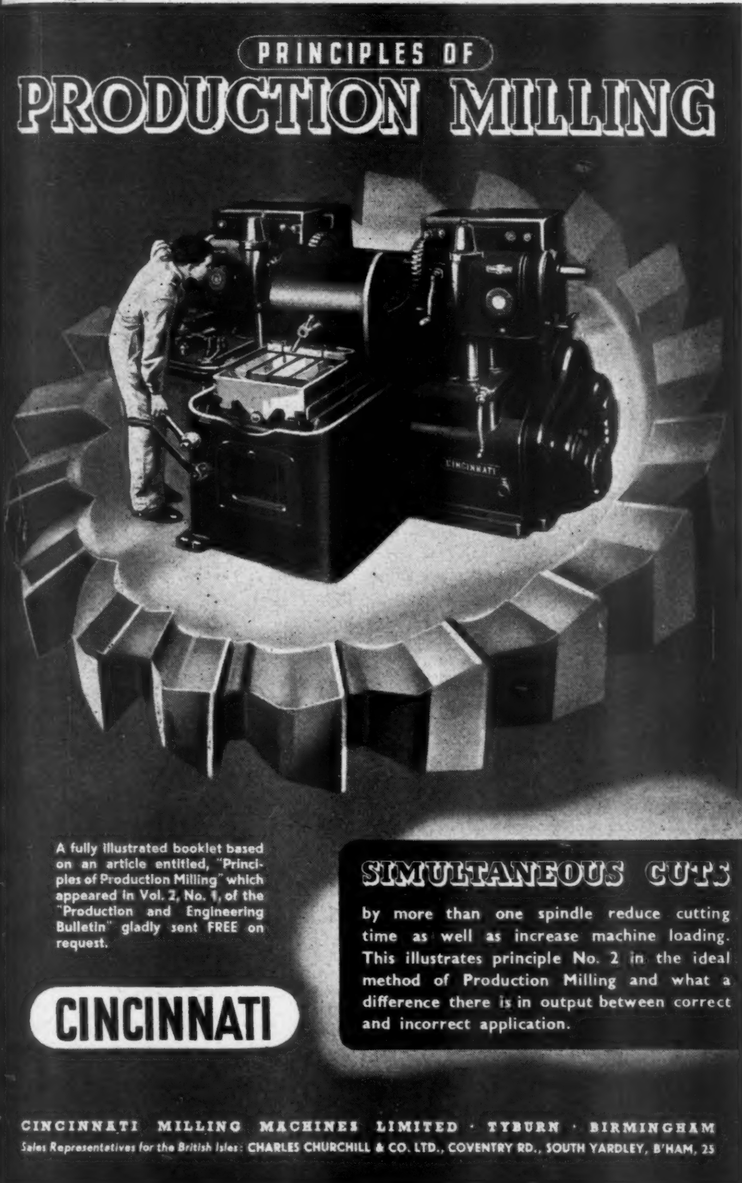

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INDEX TO ADVERTISEMENTS

As a war-time measure the advertisement section of this Journal is now published in two editions, A and B. Advertisers' announcements only appear in one edition each month, advertisements in edition A alternating with those in edition B the following month. This Index gives the page number and edition in which the advertisements appear for the current month.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in "The Journal" should not be taken as an indication that they are necessarily available for export.

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JULY, 1943

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INSTITUTION NOTES

July 1943

Annual Election of Officers.

The Council of the Institution have elected the following officers for the ensuing year.

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Annual Election to Council—Official Notice.

NOTICE IS HEREBY GIVEN of an election to fill fourteen vacancies amongst the Ordinary Members of Council. The Councillors retiring in rotation, who are eligible, have expressed their willingness to stand for re-election and are Messrs. T. Fraser, J. A. Hanney, J. R. Sinclair, E. W. Hancock, F. A. Pucknell, I. H. Wright and Dr. H. Schofield.

Candidates for election (who must be Honorary Members, Ordinary Members, or Associate Members) must be nominated, in writing, by three Ordinary Members or Associate Members, except that retiring Councillors willing to stand for re-election do not require nomination. Each Section Committee may nominate one candidate.

Nominations should be forwarded to me at the offices of the Institution, 36, Portman Square, London, W.1. The latest date for receiving nominations is Monday, August 9, 1943.

F. Gibbons, *Acting Secretary.*

Newly Elected Members.

As Associate Members : W. V. Hodgson, A. J. Burns.

As Intermediate Associate Members : E. R. Dare, G. W. Donovan, A. C. Duckworth, P. Green.

Transfers.

From Associate Member to Full Member : E. S. Gregory.

From Graduate to Intermediate Associate Member : H. Busby.

Publications of the Institution.

The Publications Committee wish to state that reprints are now available of the following papers :

(1) " Production Control," by R. Appleby.

(2) " High Speed in the War Production Shop," by Dr. G. Schlesinger.

Members wishing to obtain copies are asked to apply to Head Office.

The price of these publications is 2/- post free.

The attention of members is also drawn to the various publications of the Research Department which are available.

Report on Surface Finish, price 15/7d. post free (Members only 10/7d.). "Acceptance Test Charts for Machine Tools," Parts I and II. Price 5/6d. "Accuracy in Machine Tools," Price 3/3d.

Also various reports which have from time to time appeared in the Institution's *Journal*.

SOME POST-WAR INDUSTRIAL PROBLEMS

Paper presented to the Institution, Manchester Section, on October 17, 1942, *by A. P. M. Fleming, C.B.E., D.Eng., M. Sc., (Tech.), M.I.E.E., M.I.Mech.E., F.Inst.P., F.C.G.I.*

MR. J. W. DAVIES: Ladies and Gentlemen: On behalf of the Manchester Section of the Institution of Production Engineers, it is my privilege and pleasure to welcome this afternoon Dr. Fleming. It may seem redundant to introduce Dr. Fleming to a Manchester audience, seeing that he is not only of local, but national and international reputation both in engineering in all its branches, technical, practical and research, and most of all the educational side of engineering. The subject of his talk this afternoon is one of vital interest to Production Engineers, seeing that industrial problems form a large part of our daily menu. The war has brought to our notice many industrial problems, and we are keenly aware that when the war finishes, which we all hope will be soon, there will have to be possibly very vital changes in our industrial outlook.

The lecture of our guest this afternoon will, I am sure, be of the greatest interest to Engineers, and particularly Production Engineers. I do not want to say anything more at the moment—I will ask Dr. Fleming to address you.

DR. FLEMING: Mr. President, Ladies and Gentlemen: I have had the pleasure on more than one occasion of addressing the Institution of Production Engineers on technical subjects. When you kindly invited me to address you today, I thought that it might be well to avoid talking on technical matters, and rather to direct your attention to the discussion of problems with which sooner or later we shall be confronted, at, we hope, no distant date. It was not without some trepidation that I suggested talking on post-war problems, because we hear a great deal nowadays about post-war planning. Sometimes I think we are thinking rather too much about it, because there is a tendency to plan for things which are in a very nebulous state and on matters at present very ill-defined. To this extent I think there may be a lot of time wasted which could be better used in other ways, but at the same time it is important to think of post-war conditions as they affect each of us. By so doing, our minds become receptive of influence and conditions that may bear on these problems with which we will be most closely concerned, and to that extent we may

be able when the time comes to make the transition from the strenuous times of war to what may be the no less strenuous days of peace, more easily.

Of the many post-war problems there are those connected with such matters as international finance, the clearing up of the Lease-Lend Act, far-reaching economic problems, reforms of a social and educational character. Then we have the obvious problem of the reinstatement in industry and in commerce of all those people who are with the Fighting Forces.

A few weeks ago, Mr. Shipley Brayshaw sent me a copy of an essay he had written entitled "Employment for all." I found it an extremely thought-provoking essay, and one which I think embodies views which may be of the greatest value and guidance when this problem of re-employment arises. But of all the post-war problems, those affecting industry are perhaps in a way the most profound and the most important—important because it is that transition from raw materials to finished useful commodities which we call industry, which is the basis of the material well-being, and, to a great extent of the social well-being, of the whole community. It seems to me that the key-note of the post-war industrial problem or group of problems, as the case may be, lies in what view we take of the Atlantic Charter. You will remember that one of its clauses indicates that the raw material resources of the world shall be made as available as possible to all people, victors and vanquished alike. Another indicates that efforts will be made to ensure the most complete collaboration between all nations on standards of labour, standards of living, and all the conditions that will enable each community to develop economically in the best possible way, sentiments with which I am sure we all agree in principle, but to carry them out must surely mean a very great deal of international action and arrangements of a magnitude and character we have never had before in this world. We may get some experience in this direction, because I should imagine that one of the first big problems when hostilities cease will be to distribute food internationally, to take food from wherever it is available and in any kind of abundance and get it to the starving peoples, particularly in Europe. There would appear to me to be the same sort of problem in connection with the distribution of raw materials—certainly if the ideas embodied in the Charter are to be implemented—and we may even get to such questions as the rationing of production and of products themselves. Now one can hardly think that this interchange can go on unless trade barriers such as the tariffs that normally exist are removed. The solving of the problem will certainly provide us with some experience which will enable possibly new methods of commercial trading to be established. Possibly it may lead to simplification of currency exchange and international credits. That would seem to me to

be the only way of dealing with some of these problems and some of these conditions which the Atlantic Charter visualises.

But to bring the matter nearer home, we as Production Engineers are concerned with making things. Now it is no use making things unless you have markets for them, and one naturally wants all the available markets for products after the war. All sorts of conflicting ideas are put forward—some people visualise very hard times—others think we will all have work in plenty and so on. However that may be, it would seem that with the war destruction in this country, the wear and tear of plant, the back-log of products that in normal times would have been employed, may provide home demands of considerable magnitude in all the engineering fields, which, if wisely spread over a period, would at any rate give time for readjustment. Similarly one may think of the destruction on the Continent and feel that our Allies particularly may require help of the kind we can give them on production, but that again must depend, I suppose, on what sort of production facilities remain after this war is over, and what may have been established in the arrangements with the Germans. But perhaps it is the overseas markets of the Empire which in pre-war days absorbed a large part of our production and enabled this country to sustain a considerable part of its population. It is in this direction that one sees the possibilities of far-reaching changes. After the last war, many of you will remember that small countries became producers. In this war we have established in Australia, South Africa, India, Canada, productive facilities far beyond anything that existed in pre-war days and relatively very great in proportion to their population and normal home markets. It would seem probable that these productive facilities will be maintained and become centres of distribution for products with which they can deal within the regions of economic transport. Should that be the situation we may well have to consider whether in the future we should export people or goods.

We can speculate on these and all kinds of problems, and we would probably change our minds as to the nature and character of these problems every six months as the war proceeds, but whatever may be the character of our problems as far as we are concerned as Production Engineers, there are two factors which will be fundamentally important whatever the shape or character of things to come. These are development resulting from research, and the education and training of the personnel employed in industry.

Considering research for a moment, this country in the last twenty-five years has become research minded. Prior to that time there were few industrial research laboratories, very few indeed, in fact you could count them on the fingers of one hand so far as this country was concerned. Germany had gone ahead a good deal earlier,

and the U.S.A. had also made a good deal of progress. The first efforts were made in this country about 1912, when the Government sought to establish some means of organising research for the benefit of industry as a whole. The outcome was the Research Associations attached to each of the main industries for the investigation of problems common to the industry. The Associations were subsidised to a very considerable extent by Government funds. That movement had a very great influence. For the first time it brought competing interests in each industry round a table discussing mutual problems, and solving them by communal attention. Many of these Research Associations have prospered and are doing splendid work. They certainly had the effect of stimulating interest in research, and as a result many large firms established their own research organisations. The most striking evidence of the industrial benefits of research are shown in this war-time when thousands of young scientifically-trained workers are pursuing investigations and developments for problems of defence and destruction, with results that are stupendous. One wonders what would have been the industrial picture in this country had we been able before the war to have directed all this concentrated energy on improving peace-time products. Research has been a very misused term. Many people, when thinking of research as applied to industry, picture a lot of chemical apparatus, test tubes and complicated electrical gear, and a lot of very peculiar people who devote their time to work which in the ordinary course of events would be settled by "Bill" in the shops quicker and with much less trouble. I look upon research in industry as work carried out by anyone in any direction which will improve the efficiency of operations, whatever they may be. Viewed in that light, it concerns itself, for instance, with markets. Take overseas markets—instead of overseas business by a firm being developed by perhaps one of the heads of the organisation going abroad paying visits, it should concern itself with more detailed study of the purchasing possibilities of that country or district, the kind of goods wanted, etc.

As Production Engineers, you are fully acquainted with the research which is directed to the more effective use of materials and of human effort, with the planning of the correct balance between man-power and machine-power, with the careful planning of sequence of operations and the balanced means of production, in each organisation. In connection with research on materials, there is much to be done in the substitution of existing by other cheaper or better materials. In connection with materials, one of the great weaknesses today particularly in engineering—though it probably applies equally to other industries—is that we have not yet succeeded sufficiently well in marrying the experience of the material producer and that of the material user. Both have knowledge which could, if coordinated, be utilised to effect great improvements. I

look in the future to much of the progress in engineering coming from improvements in materials, from a much more scientific preparation of materials, a more scientific knowledge of their uses. Then there is the scientific planning of processes, which otherwise are likely to be of a rule-of-thumb order. It is not always difficult to devise new scientific processes; what is often more difficult is for the researcher to "sell" his ideas to the man in the shops who has to put the process into operation. The researcher knows all about the scientific aspect of the process but he does not know the language of the shops and does not know how to get his ideas over.

This brings us to the next stage of research which is one concerned with keeping, in the case of engineering plant, the designers fully informed of new developments, new scientific knowledge that has a bearing on his work, new materials which have become available, mathematical investigation of new phenomena that may apply to his particular problems, etc. This is a field of research which is very necessary if concerns and firms are going to keep in the van of progress. Then beyond that there is the research which concerns itself solely with adding to the sum of scientific knowledge out of which may come industrial applications. I remember hearing a very well-known industrialist in the United States say that the greatest assets his company had were the things they did not know. His concern had a very successful research organisation, and he was looking to the great storehouse of unknown knowledge to provide his new and improved products for the future.

Let us consider how this works out. A scientist or an inventor may get a brainwave or he may be led to the exploration of some chance phenomena from which some entirely new scientific knowledge is disclosed. Now he may, if he has the necessary experience, carry out experiments to verify this brainwave he has. Or an industrial research worker, hearing of the discovery, conceives its possible use in industry and carries out experiments to test the idea. In the old days, the time-lag between a scientific discovery and its industrial application was very great—maybe a matter of generations—but in these days things are done in a very much shorter time, due to the fact that research is organised. Assuming that the industrial research worker finds by experiment that the industrial use for the new discovery which he had in mind is feasible, he has then to find someone who will put up enough money to make the pilot plant, to test out the new process, or produce the new material, or manufacture the new device, whatever it may be. This plant must be large enough to produce on a scale sufficient to prove from an industrial point of view whether the new material, process or device can be economically produced to compete with an existing product or create a new demand. When this stage is surmounted all right, then it is necessary to get some financier who will put up the money to carry

the project into full-scale production and distribution. This involves setting up productive facilities and staff.

In that way an abstract idea becomes converted into a concrete entity. It was by some such stages that the radio industry developed. In 1856 Clerk Maxwell mathematically deduced that electro-magnetic energy could be transmitted through the ether of space. Some years later Hertz experimentally tested the theory, and nearly a generation later Marconi and later Lodge and other workers carried out experiments on a pilot scale. You will recall the famous " S " signal sent by Marconi from Poldhu to Newfoundland—the first Transatlantic wireless signal. Within a few years, and by crude apparatus, radio signals could be sent out from ships at sea. You will recall that the first news of the " Titanic " disaster somewhere about 1910 came by such signals. Radio telephony was developed during the last war, and subsequently came broadcasting, bringing in its wake one of the most extensive industries of modern times.

In this war period work on radio development has proceeded at an enormous rate and has extended in every way, its value in war defence through radio-location being particularly emphasised in the Battle of Britain. This is just one of the many applications of research work which this war has brought out, and which will have great value in peace time. Similar general developments are taking place in the motor car and aircraft industry.

Sometimes we are apt to think that economic progress is just a sort of perpetual motion idea—we do not realise that it needs continual stimulus to keep it going. Sometimes too, we are apt to think that all the real things have now been discovered, but there is no doubt that out of the great storehouse of unknown knowledge there remain far more possibilities than have ever yet been developed —possibly entirely new industries, certainly new materials and processes. All start from the idea in somebody's mind carried through all the successive stages of development which I have described.

We hear sometimes a good deal about the need for extending research. There is everything to be said for extending research activities, but I think there is a great deal more to be said for utilising more effectively the research work that has already been done. Of course, I do not need to talk to any Production Engineer about the significance and importance of planning—getting exact data, realising the importance of balance, and seeing that you get your machine capacity in your factories balanced so that you do not have one part standing idle and another overworked, to plan operations so as to ensure the most economical and efficient production, and to see that you get a continual flow of goods from the shops. All these things are familiar to Production Engineers. What is not so well appreciated is the need for constant vigilance on new knowledge

that may have applications. This vigilance is easy to effect in those concerns that have research and technical staffs—they are always on the look-out for new knowledge and they can see that it is distributed properly. It is not so easy for the small concern, and I think it is well worth while for these concerns to appoint a small staff competent to evaluate new knowledge as it becomes disclosed and to see whether it can be applied in the more efficient production of the company's manufactures.

Turning now to the question of the education and training of personnel, there is always much to be said about education and very many people to say it. This is particularly true at the present time. The T.U.C. has issued a Report on the general subject, the Conservative party has produced two memoranda, the Nuffield Trust has investigated many phases of the problem. These are only a few of the efforts that have come to my attention.

If we look at education and training as it affects us in industry, we have three educational levels from which people come into industry. The first is at the normal school-leaving age of 14+, when the greatest number of young people enter industry. The second is the Secondary School level of from 16+ to 18+, and the third is from the Universities and Technical Colleges. All of these educational levels and the conditions leading up to them will, I think, be subject to a good deal of change after the war. The school-leaving age, already approved to go to 15+, will, if some advocates have their way, go to 16+ with continued part-time attendance at day school to 18 years. Many people will agree with these plans, but their carrying out is a different proposition, the principal obstacles being the difficulty of providing suitable teachers and school buildings for the increased numbers and the very desirable smaller class. It is estimated that something of the order of 75,000 to 100,000 new teachers would be required and something like 10% to 15% of the whole building capacity after the war. We hear rather a lot of talk about equality of opportunity which is so often mistaken for equality of achievement—two very different things. The best thing we can do is to ensure that every boy and girl gets the chance of reaching that educational period appropriate to his or her mental capacities.

Assuming that none of the far-reaching educational changes are implemented for some years, we still have problems waiting which can be dealt with and which fall within our scope. One of these concerns the youngster who enters work at the age of 14+ and is then a free agent and does not continue his education if he does not want to. He may be induced one way or another to attend part-time evening classes, and, if he is following an engineering trade, he will be advised to take a preliminary technical course for two years. The mortality rate during this course is fairly considerable, but supposing

the youth reaches this stage—and with many that is about the ceiling as they are not mentally so adjusted that they can go much further—then much encouragement should be given to the youngster to pursue part-time education of a general cultural kind which will encourage him to form judgment of his own and not always have to be helped along. I think we can get the beginning of a good deal of useful work in that direction. Ultimately we would continue education on a part-time basis, but whether of a cultural or technical character is a matter which would have to be determined. Some of the youths who enter industry at 14+ proceed by way of part-time evening study to Ordinary National Certificate before reaching their ceiling, while a very small percentage attain the Higher National Certificate which puts them on the same level, as far as the Professional Engineering Institutions are concerned, as the University Graduate. These students are the salt of the earth, who need every help and encouragement. Too often they have to do all their study in the evening ; in some firms they are allowed time off, two afternoons per week or something like that, for attendance at technical classes, but against this they may have to do a certain amount of overtime as and when required. The strain is far too much physically and mentally, because they have to try at assimilate technical information when too tired to do so. I feel sure that any part-time release for technical instruction that firms could grant would be time very well spent. The men who get on by such efforts are the men who have the guts to tackle the job in their own time, who give up their leisure to study when they are probably tempted to spend it in much less strenuous ways. Their self-sacrifice is great and they deserve every help and encouragement.

Many years ago a great educationist laid down the dictum that every job, however mean or humble, should be taught scientifically, i.e., so that it could be performed with the utmost efficiency. That, I think, must be one of the fundamental aims of all our continuation educational work, and one of the problems on which, I think, we might well exercise our voice is to try and determine what shall be the balance of cultural and technical education for the different types of pupils.

There are certain other aspects of education and training which seem to merit consideration as post-war problems. One is in connection with our overseas trade. Firms doing overseas business should encourage young men from the overseas countries with which they trade to come to this country for practical experience and for further education. The British Council has done a good deal to encourage this movement. Speaking from many years of experience, I would urge the importance of attracting young men from overseas, especially from parts of the Empire, for training. These young men become our very best commercial missionaries. Another phase of

industrial education that we should be especially interested in is the training of higher executives. Only in this way can be avoided the decline in management that one has seen so often with concerns that earlier had shown considerable progress. Every concern—great and small—should very definitely attempt at an early stage to earmark its most promising young men and provide them with as wide experience as possible, sending them, if practicable, abroad to see something of overseas markets. In that way, firms would have a pool of men from which could be drawn all men needed for the higher administrative positions. I would make it almost compulsory, if one could have this kind of compulsion in industry, to have something of this sort done so as to ensure continual progress and avoid the fading out of the concern because there has not been enough foresight in the part of those managing the concern to ensure continuity of management. Despite the upheaval of world affairs, I do not believe nor do I suppose any of you believe—that the end of the war is going to bring the millenium. There will be a period of reconstruction, and we shall be fortunate indeed if there are international leaders of wisdom, imagination, and experience to keep a balanced view of all the conflicting interests and get the ship again on an even keel, and prevent any enthusiastic and perhaps over-zealous people from trying to introduce reforms that are really out of balance with the whole structure. This can easily happen—we might for instance, find our industry under the compulsion of Government control. Personally, I think that would be bad in this country. We have had a great deal of it in war time—it is necessary —but I think we would be losing our birthright if we had not a great measure of individual capacity left to us. I hope and believe that we shall proceed on traditionally British lines, progressively step by step, adapting our procedure to that goal which a growing social consciousness directs—more equal distribution of production, more equal opportunities for all, a recognition that industry is primarily a service to the community. But however this may be, the two fundamental factors that I have referred to—research which will keep us in the van of progress, and the training of personnel which will enable our productive machinery to function most efficiently— will always repay the closest study.

Mr. J. W. Davies (President): We have listened to the very lucid and thought provoking address of Dr. Fleming. There is only one thing I am troubled about and that is that the address to which we have listened should go further than this room. It is something which is applicable not only to us here, much as we can disseminate the knowledge and ideas we have gained, it is worth broadcasting to a much wider audience than here.

There are many points which have been raised on which perhaps

we would like, many of us, to elaborate, but it is not the duty of the Chairman to occupy the time.

It is open to the meeting to ask, and Dr. Fleming will be only too willing to answer, any questions which are put to him on the subject about which he has been speaking.

I hope anyone asking questions will give their name.

The meeting is now open, so I will ask for someone to open the discussion.

Discussion

Mr. T. Fraser : I have listened this afternoon with very great interest to Dr. Fleming. I have known him for many years and been "ticked off" by him many times over a period of years. Dr. Fleming has dealt this afternoon with research and its effect on post-war problems. There were times when I was not too impressed by research in the past, and perhaps to some extent I was influenced by the fact that in the Company we had to pay for all research development out of our own pockets. That was always a point with us. We used to say "Look what we have been paying for research and what is it doing for us ?" Over a number of years I have now got to the point where I send to the Research Department to see what they can do for us, they will sort it out. There is not the slightest doubt that research will definitely have its effect on post-war problems.

Then again, from my limited experience in industry, I find that due to the rush and pushing demand for materials nowadays, I am quite convinced that we are not metallurgically minded. Think of the number of times one gets in industry today faulty material. Material comes along for a part of a machine and is scrapped. One can only come to the conclusion that that again is due to our not being research and metallurgically minded. I am quite certain there is a post-war demand for more research to be put into the raw material side of steels and all kinds of metals.

Dr. Fleming raises another point about the distribution of food and raw materials. That is an international matter. I would like to ask Dr. Fleming how he is going to overcome the international problems of the standard of living in China, Japan, India, and even Turkey and Russia to the standard of living in this country.

Then again, Dr. Fleming has referred to education. I would not, for one moment, attempt to make any suggestions to Dr. Fleming. I know the effort he has put into education and research. I am more than pleased to see he has won out and is now an international figure on these particular problems, but there is a point which occurs to one. Dr. Fleming refers to three stages of educa-

tion, i.e., elementary school, secondary school and University. There is a feeling among the poorer class of people that they do not get the opportunity to get into the University, to obtain this higher education, and perhaps the reason for this is, in a lot of cases that they do not know, they have never been shown the way. I do feel that some kind of propaganda as a post-war measure is due to these people to let them know that if they have the mentality and if they have the brain—and I am quite certain amongst the working classes of today the brain is there, they do not know how to develop it—propaganda in that direction, in my own opinion, is well worth while and should be made available, and I would ask Dr. Fleming if he has thought of it from this point of view.

Dr. Fleming: I am interested in Mr. Fraser's remarks and appreciate them very much.

I do not know what is the solution to the problem of international distribution, but I think that from the point of view of ordinary humanity the world will somehow or other have to feed the starving peoples for a while. This emergency may be overcome by some arrangement of international lease-lend—I do not know. But once that is over and one gets to a stage where countries are beginning to "rev-up" under their own steam, then the international arrangements will fall into a different category.

Whatever international trading arrangements are made, I hope that the nations will be wise enough to conduct their production of all goods on the basis of efficiency—each specialising in producing what it is best fitted for. Otherwise we shall have to provide ourselves with barriers here and tariffs there to protect industries which cannot stand on their own feet. But how that will be done in the case of those cheaper-living countries like China and Japan one does not know. Personally I hope that a country like Japan might sink.

Mr. Fraser has touched on a very important point with regard to providing opportunities for all to reach educational levels commensurate with their ability. One war-time measure is a good beginning to our achieving this end. I refer to the Government Bursary Scheme which enables all young people of a sufficient secondary school standard of education to proceed to a special University Course regardless of family means, as the scheme provides adequate maintenance allowance for the University period.

This is—as I have said—a war-time measure, but it is a long-term and farsighted policy which I think will be successful and will mark the beginning of a more permanent educational reform.

Another scheme put into operation as a war-time emergency measure goes part of the way towards helping young men who are already in industry and who require assistance to carry them

to a higher level of technical achievement. Still other schemes are in process of development. One of these will enable youths who live in the non-industrial areas as, for example, Cornwall, Devon, Dorset, etc., to secure the financial aid necessary to enable them to get the same opportunities as the boys who are better placed geographically. In one phase of educational practice we are badly lacking, namely, proper vocational guidance for young people.

When you think that there are something like 22,000 different occupations in this country, you realise how important vocational guidance is and how meagre are the facilities for providing this. I very much hope that a great deal will be done in the post-war educational reforms to remedy this defect.

MR. LORD: On the educational side I did not know quite the line Dr. Fleming would take this afternoon. I served my apprenticeship in the days when we had to commence at 6-0 a.m. in the morning for a 54 hour week. I was fortunate enough to be with a progressive firm and thus enabled to go to the technical school two half days a week, and when that course was finished I then attended a technical school for three nights a week. I can quite appreciate the strain, physical and mental when working long hours as, with the exception of allowing myself Saturday afternoon off for Rugby football in order to keep fit and attending church on Sundays, I had very little time in which to do my homework.

A post-war problem will be the reduction of hours of the working week. It was a great step to reduce hours to 47 and I think that very great stress should be given to procure a shorter working week which generally will give young men more recreative hours and time whether they are able to do it in the firm's time or otherwise—to improve their knowledge. I am afraid that this will have to be in the range of international affairs because obviously we shall still have international competition to meet.

We shall have to cater for foreign countries to fulfil many needs and possibly we shall be thwarted to some extent by the economic situation. I was on the continent for a number of years and was amazed to find, although they had a 47 hour week there, it was quite possible on the French Railways for a man to be a signaller for 47 hours and put in another 20 or more as a porter, thus getting round international agreements.

I am interested in the question of encouragement by employers to people showing outstanding merit in order to equip them for the highest places in the management of the concern and it is quite possible that the Lancashire adage " clogs to clogs in three generations" originated from the fact that the ill-equipped grandson married an impecunious handsome woman and paid little attention to the business which therefore went bust. In the old days the boss's son always had the job, which often lead to degeneration.

It seems to me there must be a broader outlook by the selection and encouragement of boys who have natural ability to rise to the top and also broadmindedness in assisting these people in getting to the top after seeing they are of the correct type.

Mr. Walsh : Dr. Fleming has given us a splendid address and indicated ways by which promising lads should get on. I am applying my remarks to the engineering trade and the fitness of those who are responsible, but I am bothered about what we are to do with all the lads who come to the age when they must go into industry. At the present time we have Trades Unions and there are only a limited number of lads who can be taken into these Unions. A big firm might take in 600 lads a year and only 200 of them enter a trade, 300 of them have to go on semi-skilled work and the remainder of them on blind alley jobs, labouring and plain unskilled work.

I would ask Dr. Fleming is he in favour of facing up to this question and going in for the abolition of Trades Unions and the methods we have used up to now for training lads to a particular trade. Another thing which makes it that lads have no chance today is that we are upgrading labour and many are of the opinion that the labour which is upgraded is as good as that of men who have served their time to the trade : Therefore I would think a post-war problem would be to look at the thing broadly and give every lad a chance of getting into the particular line of work which he likes and chooses to allow him an opportunity of getting on equally with every other lad.

Dr. Fleming : I think Mr. Walsh has just the same ideas as I have, only probably more so. Forgetting the Trade Union complication I think the starting point of trying to plan beforehand what you can do with boys really ought to rest on proper statistical surveys of how many boys are needed for any particular kind of job.

I was talking recently to the Director of the Engineering Employers' Federation and asking him for data on the number of boys normally on the register with Federated firms as compared with the present time. There are now about one-third more than were previously in the engineering trades. That is due to upgrading and to increased demand. Whether one can say now that at any particular period in post-war days one will need, say, 50,000 fitters and 20,000 patternmakers is exceedingly doubtful. If one could it might be possible to arrive at an approximate estimate of how many young people one should admit for training and so avoid the risk of a surplus.

In my Company many years ago I was faced with this problem of trying to make a guess as to how many apprentices to the various trades were necessary each year to provide the skilled adults that

would be required five or six years hence. The guess had to be on the basis of assuming:

(1) The sort of fluctuation of trade that seemed to be evident in those days.

(2) The rate of mortality among older people in the firm, (and as it happened we had a relatively young crowd of people in the Works at that time).

I found that very limited field very difficult to decide, but it was all I could do about it and I made a guess which turned out tolerably well, but there were times when we had a shortage and others when we had a surplus.

Something like 25 years ago I had the temerity to employ a psychologist to come into the Works to tell me how to select boys for trades.

I was faced with this problem. A boy was apprenticed to a trade as he came in. He was given a period of probation in which to settle down and make sure he liked the trade. Then if he stayed in it until he was 21 he became as fixed as a brick in a wall. I wanted to be reasonably sure that we made the right selection at 15 and 16. We used the best judgement we could, watching boys and their behaviour, but one had an uneasy feeling that youths who were misfits might grow up and reach the age of 20 or 21 feeling discontented without knowing why and to that extent not be too useful to the Company. To my psychologist friend I said: "Here are a group of trainees, young men I have known for some years and I can put them into order of merit on their jobs. I am going to give you their names only and you can try out any tests you like on them."

He started off blithely and tried out his psychological tests, but his deductions did not line up with my knowledge at all. Since that time, however, psychologists have advanced in the development of ways of making more scientific selection, but I am not certain that even yet these methods are more than confirmatory. I believe much more reliance can be placed on complete records of observed tendencies and aptitudes kept from babyhood to the school leaving. I believe the best plan would be—I am only thinking out aloud—to try and make arrangements whereby those boys who show aptitude for trades—and I quite agree many of the handy youths are better fellows than boys who are selected at an early age for definite skilled trades—should be given a chance of showing their skill in trades and given facilities to move round from one trade to another. I would do that in a training school. In a big works this can be done in an apprenticeship training shop where basic training can be given without affecting production too much. I think boys should be diverted from one to another trade and in that

way be given some of the flexibility which is wanted. If one could do this it would ease the situation a good deal, because it is not all boys who have the aptitude to justify long years of skilled preparation.

To sum up, I believe first in trying to discover aptitude—and I think a good deal of work will be done in that direction after the war; and then in giving trainees flexibility to move from one job to another—but that is a problem which requires the consideration of the Trade Unions.

MR. SCHOFIELD: I would like to put a question that really joins two points you made, one about the absorption into industry of people coming from the services after the war and students also, a number of those who have taken the Higher school certificate. I was wondering under the Essential Works Order how this applied to these people. It was promised when that was introduced that there should be no frustration to ambition.

One finds oneself in a rut and of course one has to accept that position, or alternatively one is told to go into the Services and you will be in a bigger rut still. What is my position, I can get no opportunity in industry. Are opportunities then given to people coming from the Services from Commissions? I am frustrated and should like to know what will happen when the post-war time comes.

DR. FLEMING: There is in the Services a very great demand for young men who have reached the standard of the Higher National Certificate in engineering and who have had considerable practical experience. In fact, the demand—more particularly in mechanical engineering—is far greater than the supply. I happen to be well aware of this fact because I serve on the Technical Personnel Committee. Men with these qualifications are considered by the Allocation Board of the Services from the point of view of suitability for Commissions. On an average, one man in three qualified by technical and practical experience is chosen as suitable on personal grounds. It is no reflection on a man if he is not selected. I do not know if you have tried that particular field; it may be well worth while doing so.

It is so difficult to tell what after-the-war conditions will be but the only guiding line is that we have to see that as far as it is humanly possible the men whose careers have been interrupted should have the opportunity of continuing their preparation and complete training for that career. Those who joined up before they had begun to make any serious preparation for any particular career should be given the opportunity of deciding what line they want to get into and be prepared for it. In this matter, I hope there will be people wise enough and imaginative enough

to see the picture as a whole and not be biased by political interest or established conditions, but who will find the problem is a new one, and deal with it from that angle and endeavour to see that conditions are made to fit the men from a human point of view.

With regard to the question of hours of labour, some years ago I remember, in connection with the activities of the International Labour Office at Geneva, discussing what we could get along with in this world if the efficiency of production was considerably increased, and we came to the conclusion that the hours would be very few.

I remember some years ago discussing this problem in Russia with the people concerned with the making of lamps. Between 1932 and 1937 one factory I know increased its production many times. They said : " Our plans are made for electrifying the whole country and we know just how many lamps we need." I asked : " When you reach that point what are you going to do ? " and they stated they would reduce their hours of labour. I believe that internationally we have to recognise that conditions will have to be fitted into a new framework and not try to fit them into something which is too rigid to admit of alteration.

MR. SIDDALL : I can assure you that it is rather more than interesting to be here this afternoon to listen to Dr. Fleming. Until we got the last speaker no-one had trespassed into the labour question.

I am one of the labour supply officials who has to go about and meet the real problems of production engineers and give decisions upon them. I thought I had better come along and join you on this particular occasion to see how you go on. I suppose by this interchanging of ideas we do get the ideal. I feel sure Dr. Fleming has touched upon some very interesting aspects of post-war conditions as applying to education, but I have been rather concerned about the remarks on the Trade Union movement and want to assure you that these things are pretty well catered for and are being catered for as far as possible after the war.

I have had the same experience as Dr. Fleming of how the Russians deal with their problems and the reduction of their working week. If we are to solve our problems I do not think we are going to meet with many difficulties as regards engineering and its future and I hope employers will implement their promise with regard to relaxation when the people who were brought into industry through upgrading, etc., will go back to their routine jobs to leave room for those who went into the Army to help us win the war.

We had the pleasure, a few of us, last night, of listening to the Rt. Hon. Sir Oliver Lyttelton, the Minister of Production, and hearing from him his particular idea of what is going to happen after the war. There are many elaborate committees working out

particular plans of what is going to happen to managements, enployees, shop stewards and Trade Unions, but when we have won the war I hope we have sufficient brains in this country then to evolve schemes satisfactory to all those engaged in the engineering industry.

MR. HARRISON: I should like to ask Dr. Fleming, has he considered the financial side of the question? During the war we are building up a huge debt. After the war this will have to be paid by the export industries, which are, in the main, engineering. How can we meet that taxation which is a burden on the industry? Assuming you have three boys leaving school, one to be a doctor, one a dentist, and one a draughtsman-designer. After the war the doctor and the dentist will be better off, for the draughtsman-designer will have to face fallen demand and his wages will be extremely low.

Has Dr. Fleming any ideas from this point of view to protect the interests of people in industry after the war?

DR. FLEMING: The post-war financial difficulties will be problems for international settlement. Years ago when I was a young man, one looked on the economist as having pretty clear-cut ideas and theories and, in fact, his rulings and decisions seemed almost irrevocable on fundamental lines. The last war upset the economic viewpoint tremendously. I am not at all sure that we have not all of us got too rigid ideas on the question of finance. In 1909, Norman Angell wrote *Europe's Optical Illusion*, then in 1910 the second edition entitled *The Great Illusion*. He showed by every kind of deduction that the war could only last a very short time because financially no one could stand it. We have altered our ideas completely since then, and I think we have to reconsider finance as a whole problem and be much more flexible in ideas than we have hitherto been.

MR. MACLELLAN: Dr. Fleming states international food distribution. On this subject to my mind it actually means we are going to have an international standard of food distribution. With post-war markets pooled and well below standard, it will keep down the standard of living in this country and it will be backing a loser.

As regards research, I should like to point out that in research we have the coming thing, but there is one point and that is as regards designing. In the shops one finds a number of elderly men who have not had the education to tackle and refer to drawings as they should. To my mind, drawings should be more simply made to enable work to be carried out more efficiently, and at the same time as regards sub-assemblies, these to be taken into line production before the larger question of assemblies is tackled.

DR. FLEMING: I was thinking of food distribution as only a temporary measure. We do not know, and perhaps it is as well, the real

conditions in Europe as regards the food supply. I cannot help feeling that on humanitarian grounds we in this country would be willing to go even shorter of food than we are today, if we could ensure that the people of Greece, Poland, and some parts of Russia. for instance, would have a better chance of getting up to our level, (*Applause*).

I think until that position gets right, when hostilities are over and it is possible to distribute food—I was only using it as a temporary measure—that during the time of international exchange temporarily all sorts of barriers will have to be broken down: it may give us an opportunity of discussing whether we need tariff barriers to develop again. That is the kind of picture which I was trying to convey.

The other point regarding an easier way of presenting drawings and shop instructions, there is a great deal in what Mr. MacLellan says. I have seen efforts in America to do something of what he describes. It is very essentially a subject for the Institution of Production Engineers, and I think I will leave it to them.

MR. DAVIES: No one could accuse the Institution of Production Engineers of being hidebound this afternoon. All our discussions and talks have led us into a very wide field. You can all take home to your particular sections the details of the discussions and review them with your members.

Dr. Fleming's lecture has given us much food for thought—food distribution, education and research—and particularly in regard to research we are not, in our shops at the present time, taking full advantage of the opportunities which it has given us.

The Rt. Hon. Oliver Lyttelton, talking about production, said when we started the war we had to make reply with the plant and tools which we had. The same thing applies in our general attitude to production under normal conditions; it is the duty of the larger firms to take full advantage of the opportunities and facilities offered

MR. STODDART: I rise to move a vote of thanks to Dr. Fleming and wish to say before we disperse we should make one or two points.

Dr. Fleming mentions the Atlantic Charter and the equitable distribution of the products of this world. I cannot supply the answer. We know the commodities of this world were badly distributed before. With regard to the distribution of materials, was it possible for the peoples of the world to get materials in the market they might wish to buy. So far as the question of nickel was concerned and the free distribution, we knew that Canada had a corner in this direction.

Another point which I should like you to consider is that of research. Unfortunately this point is tied up so much with finance. The larger firms can, of course, and do, provide their own research

departments, but the large firms are few in number,, i.e., those who can afford a large research department, therefore what are the smaller firms going to do? Obviously, a lot of them cannot afford the expense of a research department and this should be a question for national assistance and control. Government control is abnormal control at present. Telephones are under Government control and show how Government control should become useful to the public and also Company concerns.

I deplore that no one mentioned a plea for courage in post-war reconstruction, courage to try out new processes, new machines, new materials and courage to give the coming generation a square deal. This country led in the Victorian era ; we are now lacking, we have need of the courage we had in the old days and we here, as individuals need courage.

MR. T. FRASER : I wish to second the vote of thanks to Dr. Fleming and in reply to Mr. Stoddart I would remind him that the Institution of Production Engineers has a Research Department and the bigger institutions are moving on these lines and making use of the Institution's Research Department.

DR. FLEMING : Mr. President, Ladies and Gentlemen.

I very much appreciate the kind remarks of Mr. Stoddart and Mr. Fraser and the way in which they put the resolution, also the cordial way in which you members of the Manchester Section of the Institution of Production Engineers have received me. It has given me great pleasure indeed to have an opportunity of talking to you. The times are difficult for all of us and one would like more time, more leisure, to think over some of the problems we have been discussing.

Research Department: Production Engineering Abstracts

(*Edited by the Director af Research*)

NOTE.—*The addresses of the publications referred to in these Abstracts may be obtained on application to the Research Department, Loughborough College, Loughborough.*

ANNEALING, HARDENING, TEMPERING.

Induction Hardening. [*The Commonwealth Engineer* (*Australia*), *An Editorial Review, March 1943, Vol. 30, No. 8, p. 183, 2 figs.*].

Surface induction hardening is one of the most recent and outstanding developments in the heat treating field and may be applied to localised or general surface hardening. The operator produces surface hardnesses which vary in the fully hardened condition and may be adapted to the hardening of steel or cast iron. These surfaces have the unusual feature of ease of machineability. Principle. Metallurgy of induction hardening. Equipment. Applications of induction hardening.

COMBUSTION, FURNACE.

Electric Furnace Brazing Technique, by A. J. T. Eyles. (*Machinery, May 6, 1943, Vol. 62, No. 1595, p. 488*).

Short account of practice and atmospheres used.

Furnace Brazing in a Controlled Atmosphere. (*Production and Engineering Bulletin, May, 1943, Vol. 2, No. 7, p. 291, 8 figs.*).

The brazing of assemblies in a controlled atmosphere furnace, known as the bright-brazing process is not new, but it is only comparatively recently that it has been applied to any considerable extent in large-scale manufacture. Typical parts produced by furnace brazing. Examples of furnace brazed assemblies. Controlled-atmosphere electric furnace installation of the continuous meshbelt conveyor type. The furnace atmosphere. Furnace equipment for bright brazing. Materials which can be brazed. The brazing medium. Capillary attraction and gravity flow. Preparing the parts for brazing. The use of jigs may be avoided by securing the parts in position mechanically, prior to brazing. Strength of bright-brazed joints. Other advantages of bright-brazing. Some limitations of the process. The temperature used in the heating chamber is approximately 1.120° C. with copper as the brazing medium, high carbon steels are decarburised and considerable grain growth is caused in the process. Large light assemblies and thin tubes tend to deform unless properly supported during their passage through the heating chamber.

EMPLOYEES, WORKMEN, APPRENTICES.

Breaking Down the Colour Line. (*The Management Review, May, 1943, Vol. XXXII, No. 5, p. 174*).

In 1941 the Winchester Repeating Arms Company, of New Haven, Connecticut, was faced with a labour shortage. To overcome it, the company decided to hire more Negroes, and within a year had increased the number

of its Negro workers from 200 to 1,500. Today Negroes work in 52 capacities in the Winchester plant. They work in the offices as clerks as well as in skilled and semi-skilled jobs on the production line. Winchester decided to give them exactly the same opportunities that it gives its white employees. White and coloured workers not only work side by side, but they also eat together in the cafeteria, play together on athletic teams, and use the same sanitary facilities. The company overcame the objections of a few white workers and convinced the complainants of the soundness of its policy by discussing the whole question with them. Negroes receive equal pay for equal work.

MACHINE ELEMENTS.

Antifriction-Bearing Developments for Aviation Engines, by Th. Barish. (*Transactions of the A.S.M.E., May, 1943, Vol. 65, No. 4, p. 261, 12 figs.*).

Rapid advances in aircraft engine design for higher powers have required corresponding improvements in antifriction bearings. From an intimate knowledge of the requirements the author presents a comprehensive outline of the progress made in bearing developments with particular reference to current practice. The discussion includes details of bearings for the following services : crankshaft, propeller thrust, rocker arm, supercharger and controllable propeller.

Bevel Gears in Aircraft, by A. H. Candee. (*Transactions of the A.S.M.E., May, 1943, Vol. 65, No. 4, p. 267, 22 figs.*).

Some important applications of bevel gears in aircraft are illustrated and described and some of their advantageous features are explained. The selection of bevel gears instead of parallel-shaft gears is dictated in many instances by the locations and arrangements of the driven equipment and the sources of power. In cases where the related parts can be arranged to suit either general type or gear, the designer will make his selection according to experience and preference.

Stop End Thrust, by John E. Hyler. (*The Tool Engineer,* May, 1943, *Vol. XII, No. 5, p. 73, 6 figs.*).

Where the thrusts endwise on a machine spindle are highly variable, and no end motion is allowable, the only safe proposition is to protect against the greatest amount of end thrust that can be expected.

Milling machine spindle design. Thrust bearing ring. Disc grinder spindle design with provision for lubrication bearings. Small grinder spindle design for chatter-free work or all faces. Thrust pillow blocks. Split leadscrew nut is also divided crosswise. Springloaded end thrust. End thrust wear compensation. End thrust wear on screws. Thrust free elements. Interesting case of counter thrust.

MACHINING, MACHINE-TOOLS.

Grind Deep-Hole Drills Properly, by F. O. Hoagland. (*The Machinist, London, June 19, 1943, Vol. 87, No. 9, p. 69, 7 figs.*).

Hand grinding limits drill life and results in rough or run-out holes. Machine grinding and the proper resharpening cycles give quality and quantity production. The modern sharpening machine for small drills, complete with roughing and finishing wheels. The V-point on small drills and the steps on large drills break chips for easy passage through the long shanks. Helical bevel on drills up $\frac{3}{4}$ in. diameter is sharpened on one side of a crowned grinding wheel. The three set-ups for sharpening step drills are shown.

CHIPLESS MACHINING.

Improved Hydraulic Presses for Wartime Requirements, by J. H. Maude. (*Transactions of the A.S.M.E., May, 1943, Vol. 65, No. 4, p. 287, 26 figs.*).

A new rapid-action self contained hydraulic press developed for wartime industries in Canada. Since this mass-production in press employs oil as the pressure medium, the power unit is of special interest. The operations for which the press is particularly adapted, namely, drawing indenting, and loading cartridge cases, are described in some detail, as are also the methods of press control. A suitable hydraulograph was developed for measuring pressure changes, and this instrument provides a permanent graphic record of tests on modern presses. The " one-shot " press and a 300-ton gun-straightening press are also discussed.

Two-stage Drawing of Cylindrical Cups, by H. W. Swift. (*Transactions of the Institution of Engineers and Shipbuilders in Scotland, May, 1943. Vol. 86, No. 7, p. 195*).

Since the principles of second-stage or re-drawing embrace the principles of first-stage or initial drawing, and since the production of a two-stage cup embraces both it is natural that any treatment of two-stage drawing should give some account of both stages. Drawing from a flat circular blank. (1) the drawing-in of the metal in its own plane. (2) a compressive stress in the hoop direction. (3) the lateral stress across the thickness of the sheet. Principal stresses during drawing-in. Principal shear stress. Drawing tension during drawing-in. Drawing tension at brink of die. Drawing ratio = $\frac{R_0}{R_1} = \frac{D_0}{D_1}$ The punch profile. Limiting drawing ratio. Summary of initial drawing process. Redrawing from a cup. Stresses during drawing-down period. Thickness changes. Experimental apparatus. Experimental methods and procedure. Redrawing tests. Guiding conditions. Tapered dies. Punch profiles. Scope of experimental work. Drawing loads and characteristics. Strains during drawing and redrawing.

Punches and Punching Operations, by John Garland. (*Machinery, London, June 17, 1943, Vol. 62, No. 1601, p. 652, 2 figs.*).

Suggestions for dealing as a whole with the stresses set up in punches in a complete cycle of operations ; with the object of securing data to rationalize design, and to help in drawing up standard charts for commonly-used sizes. Equation to calculate the intensity of stress in a cross-section of a punch. Punch of uniform diameter. Punch with enlarged shank. Punch provided with shoulder. Fracture tendencies. Stripping and punch breakage. Design formulae for punches. High-speed steel for punches. Butt-welded high-speed steel heads. Fine finish before cyaniding.

Phosphatic Coatings as Aids in the Plastic Working (cold drawing) of Metals, by A. Durer and others. (*Sheet Metal Industries, June, 1943, Vol. 17, No. 194, p. 1025*).

The authors claim that phosphate coatings applied by a special process can be of great benefit in the plastic working of metals, particularly in cold-drawing. The required drawing pressure is decreased, intermediate annealing avoided, the wear on dies and tools reduced—and most important economically —it becomes possible to use low fat-content emulsions for lubricating the work in the draw.

MANUFACTURING METHODS.

De Havilland Mosquito, by Wilfred E. Goff. (*Aircraft Production, June, 1943, Vol. V, No. 56, p. 263, 31 figs., and No. 57, p. 315, 38 figs.*).

Part I. The World's fastest aircraft in production : moulded, split-fuselage construction : wing-spar manufacture. The De Havilland Mosquito is the first modern first-line machine of all-wood construction to go into service. Structurally, the most outstanding feature of the aircraft is the fuselage, built on the balsa-plywood sandwich principle. The power plant consists of two Rolls-Royce Merlin XXI engines, each developing 1,260 b.h.p.

Part II. Wing assembly : Tailplane, fin and flaps : undercarriage : final assembly. The Mosquito wing is notable for the fact that with the exception of the small wing-tip sections, the entire unit is built in one piece. The production of the undercarriage leg is another interesting departure from standard practice, as use is made of rubber blocks for shock absorbing, in place of the more usual oleo-pneumatic arrangement.

Aerial Cameras, by J. A. Oates. (*Aircraft Production, June, 1943, Vol. V, No. 56, p. 280, 29 figs.*).

Used extensively by the R.A.F., the F8 aerial camera incorporates many interesting photographic, electrical and mechanical features. Because of the precision nature of its mechanism considerable care is necessary during manufacture to ensure that all dimensions are held to close limits, and that the various units are interchangeable between cameras. This has been achieved by the introduction of a very efficient gauging system. From a production viewpoint the methods employed are interesting because the equipment is manufactured on the batch principle, the same machine tools being used for a variety of operations.

Radial Drill Press Operations—III and IV. (*The Machinist, London, June 19, 1943, Vol. 87, No. 9, p. 95*).

(1) Line up part on table. (2) Time to drill cast steel. (3) Time to drill cold or hot rolled steel.

Marking Methods and War Production, by A. Throp. (*The Engineer, June 25, 1943, Vol. CLXXV, No. 4563, p. 512, 14 figs.*).

The principal factors involved are : (a) The available methods by which the lettering of marking dies is made to stand up in relief. (b) The load required to secure indentation. (c) The available means for presenting the die to the work. (d) The geometry of the interaction of the die with the work. (e) Stresses arising in the tool exactly as in machinery parts. (f) The selection and inspection of a suitable steel for the die. (g) The heat treating of such a steel in a way to achieve simultaneously high hardness, high toughness, freedom from scale, decarburisation, and cracking in treatment. (h) The plastic flow of material produced in the process of marking. Electrical etching machine. Standard steel type used for circular marking. British marking machine. Marking machine for conical work, e.g., time fuses. Flat die for marking aluminium alloy tube. Anvil used when marking fuse after assembly with other items.

Fabrication of Light Alloys, by A. G. Arend. (*Metal Treatment, Spring, 1943, Vol. 10, No. 33, p. 23*).

Machining, finishing, drilling, riveting, welding and heat treatment of Mg-Alloys.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Fixing Bearings in Steel Shells without Using Tin, by W. Coopey. (*Metal Progress, January, 1943, Vol. 43, No. 1, p. 75*).

A letter describing a method in which 95/5 Pb-Ag alloy is used for " tinning " the steel or bronze shell in preparation for lining it with Pb-base bearing metal. Zinc ammonium chloride is used as flux.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Finishing Metals by Band Filing, by H. J. Chamberland. (*Iron Age, March, 1943, Vol. 151, No. 9, p. 54*).

File bands for continuous filing have been developed for non-ferrous metals. They consist of file segments 3 in. long mounted on a band of high grade spring steel.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Recent Developments in the Formation of Aluminium and Aluminium Alloys by Powder Metallurgy, by G. D. Cremer and J. J. Cordiano. (*Amer. Inst. Min. Met. Eng. Paper, Feb. 1943*).

A number of Al alloys such as Al-Cu, Al-Cu-Mg, Al-Cu-Mg-Mn, can be made by powder metallurgy using powders made by atomisation and properly lubricated dies. Their mechanical properties are claimed to approach those of case and wrought alloys.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Iron Powder, by C. Hardy. (*Metal Progress, January, 1943, Vol. 43, No. 1 p. 62*).

Classifies the available types of iron powders into five groups, discusses costs and describes non-metallurgical use.

(*Communicated by the British Non-Ferrous Metals Research Association*).

MATERIALS, MATERIAL TESTING.

Alternative Bearing Materials. (*The Commonwealth Engineer (Australia), April 1, 1943, Vol. 30, No. 9, p. 209*).

Practically all the bearings that are used in Australia at the present time are of the sleeve type. Bearings of this type should possess the following characteristics : 1.—Sufficient mechanical strength and resistance to thermal stresses. 2.—Low value of friction. 3.—Resistance to seizure. 4.—High thermal conductivity. Table 1.—Compositions and properties of bearing materials. Table 2.—Properties and applications of babbit metals. Porous bearings. Plastic bearings. Table 3.—Comparisons of properties of bearing materials.

MEASURING METHODS, APPARATUS.

The Principles of Fine Measurement, by R. E. Blakey. (*Machinery Lloyd-Leicester, June 12, 1943, Vol. XV, No. 12, p. 37, 6 figs.*).

Primary standards of length. The yard and the metre. Secondary standards of length. The standard yard, a bronze bar (32 Cu,5Sn, 2Zn) and a prototype metre in Platinum Iridium are our reference standards of length. Materials used in the construction of standards. Comparison of line standards. The importance of temperature. Subdivision of line standards. Natural standards of length. The use of light. Standard gauges. Comparators and indicators of high sensitivity.

Latest Developments in Glass Gauges, by T. J. Thompson. (*The Tool Engineer, May, 1943, Vol. XII, No. 5, p. 78, 8 figs.*).

Last minute notes on practicability, designing and machineability with consideration of physical characteristics of glass, and photographic studies of other industrial uses for glass which gauging success has stimulated. Design of glass gauge blanks. Plug gauges. Ring gauges. Plug gauge finishing. Physical characteristics of glass. Hardness. Mechanical strength. Elasticity. Mounting plug gauges in handles, though not required in gauge construction, metal can be soldered to glass. Marking of glass gauges. Storage of glass gauges. Glass gauges performance.

PLASTIC MATERIAL.

Plastic Punches Form Aircraft Sheet Metal, by Vega Aircraft Corp. (*Iron Age, February, 1943, Vol. 151, No. 7, p. 68*).

A thermoplastic synthetic resin called Plastalloy (produced by the Plastalloy Co. of U.S.A.) is poured into a Kirksite die to make a punch for metal press-working operations. Good service results are claimed.

(*Communicated by the British Non-Ferrous Metals Research Association*).

Plastic Bonding of Metals. (*Aircraft Production, July, 1943, Vol. V, No. 57, p. 313, 3 figs.*).

Synthetic resin adhesives. Specimens of lap joints in duralumin sheet made with rivets and by the Redux process. Results of tests to find the variations with temperature of the strength of simple lap joints made by the Redux process. Results of tests on simple Redux lap joints to find the variation in apparent sheer strength with variation in the thickness of metal.

SHOP AND SHOP MANAGEMENT.

Ten Year's Progress in Management. (*Transactions of the A.S.M.E., April, 1943, Vol. 65, No. 3, p. 213*).

This Ten Years' Progress in Management Report is presented by the Management Division. It is the fourth presentation of its kind, the three previous reports having been written by Dr. Alford and delivered by him to The American Society of Mechanical Engineers at Annual Meetings, respectively, ten, twenty, and thirty years ago. On behalf of the very voluminous size of this report, we can only give the headings of the 16 papers and the names of the authors. (1) Administrative Organisation by L. S. Fish, Washington, D.C. (2) Purchasing by Stuart E. F. Heinritz, New York, N.Y. (3) Defunctionalisation of Industry by H. H. Farquhar, Alexandria, Va. (4) Gauging and Inspection in Interchangeable Manufacture by C. deZafra, New York, N.Y. (5) Statistical Control in Applied Science by W. A. Shewhert, New York, N.Y. (6) Job Standardization and Work Simplification by H. B. Maynard, Pittsburgh, Pa. (7) Cost Accounting and Budgetary Control by J. A. Willard, New York, N.Y. (8) Industrial Marketing by H. J. Loberg, Ithaca, N.Y. (9) Job Evaluation and Merit Rating by Asa S. Knowles, Kingston, R.I. (10) Wage Plans by I. M. Juran, Washington, D.C. (11) A History of the Man Situation by C. G. Marcy and M. M. Boring, Schenectady, N.Y. (12) Labour Relations in Evolution by W. R. Burrows, Schenectady, N.Y. (13) Federal Administrative Management, 1932-1942 by D. C. Stone, Washington, D.C. (14) Increase in Adaptability of Workers to Job Requirements by E. W. Lancaster, Washington, C.D. (15) Management Research by E. H. Hempel, New York, N.Y. (16) Management Attitudes by E. H. Schell, Cambridge, Mass.

Wage Systems and Incentives, by T.E.A.K. Jockson. (*Mechanical World, June, 11, 1943, Vol. 113, No. 2945, p. 638, 11 figs.*).

The economy of high wages and the ways in which they are successfully applied. Basic division of all plans. Inadequacies of the simple time rate. Classification of incentive systems. Claims of the straight piece rate. Gain-sharing plans. The Bedaux System. Premium bonus. Need for revision of basic rates. Time and job study essential. Non-financial incentives.

SMALL TOOLS.

Recent Developments in Carbides vs. High-Speed Steel, by H. A. Oldenkamp and J. McFayden. [*Mechanical Engineering (U.S.A.), April, 1943, Vol. 65, No. 4, p. 253, 7 figs.*].

Jobs already in the shop are constantly being converted to carbide where-ever possible. The procedure is to arrive at a proper design for the cutter by experiment. The feeds, speeds, and other data are then recorded and turned over to the shop-toool-design department for permanent recording and the drafting of the cutter. Cutting metals and their general applications. Recent applications of carbides. Applications : Centering body being processed in a turret lathe by use of two carbide cutters. Six gear blanks in series made with one chucking operation. Warner & Swasey standard carbide planer cutters. Precautions in using carbides. Conservation of high-speed steel. Typical butt-welded cutter. Forged welded offset cutter. Summary and conclusions.

Cutting Stainless with Reverse Angle Chip Breakers. (*Iron Age, Vol. 151, January 21, 1943, p. 41*).

A novel method adopted by Firth-Stirling Steel Company, for rough-turning of stainless steel on which scale is present. The usual practice in the grinding of carbide tools for cutting of steel is to grind the chip-breaker wide at the nose of the tool and to taper the groove off in the direction of the shank. This procedure was reversed. The chip breaker was ground to an angle of 7°, with the narrow end of the grooves starting at the nose radius. This novel grind of the tool was found to prevent edge failure, even when using double the feed and speed formerly employed.

Grind Cutting Tools Properly, by A. M. Lennie. (*The Machinist, London, June 26, 1943, Vol. 87, No. 10, p. 130, 8 figs.*).

Magnesium and its alloys have excellent machineability. Good surface finish and dimensional accuracy are obtained with light and heavy cuts at both low and high cutting speeds. The limiting factor of cutting speeds for these alloys is the capacity of modern machine tools. Use large relief angles. Keep the tools sharp. Turning and boring. Shaping and planing. Milling. Power requirements. Recommended turning speeds and feeds. Milling feeds and speeds. Counterboring. Filing. Miscellaneous operations.

Adjustable Form-turning Tools, by O.H.P. (*Machinery, London, June 3, 1943, Vol. 62, No. 1599, p. 605, 5 figs.*).

These tools are used in finishing operations to small non-ferrous half-bearings and bushes. Consistent results are maintained, provided that the roughing operations are held to ordinary commercial limits. Owing to the adjustment feature, manufacturing tolerances can be more generous than those applying in ordinary form tools. Examples : (1) a split bush, (2) a double flanged solid bush. (3) a single-flanged bush. (4) a combination which can be provided to accommodate bushes of various lengths and diameters. A high saving of high-speed steel can be effected by using butt-welded shanks and carbide tips.

SURFACE TREATMENT AND QUALITY.

Preventing Internal Corrosion of Pipe Lines (Carrying refined Petroleum Products), by F. Wachter and S. S. Smith. (*Ind. Eng. Chem. March, 1943, Vol. 35, No. 3, p. 358*).

Internal rusting of steel pipe lines carrying petrol and other refined petroleum products can be prevented by injecting sodium nitrite.

Surface Finish and the Function of Parts, by G. Schlesinger. (*Engineering Vol. 155, No. 4037, May 28. 1943, p. 434 ; June 4, No. 4038, p. 454 ; June 11 No. 4039, p. 464,; June 18, No. 4040, p. 498, 19 figs.*).

The author begins by enunciating the principle that given good design, a machine will work properly when the material, the fits and tolerances, and the quality of the surface are chosen to suit the working conditions and then gives examples to show the improvement effected by proper attention to suitable fits, tolerances and working surfaces. The use of pen records to provide data for surface finish is dealth with, and an account is given of comparative tests of British and German aero-engine parts. Fits for various functions are discussed and attention is paid tc problems relating to lathe spindles, and the surfaces of fuel injectors. Ground and scraped surfaces are compared, and further sections are devoted to micro-finish by honing, the superfinishing process, and the dulling criterion for finishing tools, As this was a paper read before the Institution of Mechanical Engineers, London an extensive discussion is reproduced on: glass standards of the N.P.L., waviness of the surface; wear of slip gauges with different grades of surface quality, demand for simple optical surface comparators ; criterion of the influence of coolants on turned or milled surfaces ; superfinishing success with water-lubricanted thrust bearings ; explanation of advantages and disadvantages in producing best bearing surfaces from sand-blasted to superfinishing quality ; the necessity to study not only the geometrical state of the surface but also the chrystalline nature (Beilby layer) ; the point of view of fatigue and stress concentration ; the distinction of the effect of different lapping abrasives ; the taper sectioning method ; the selection of useful tolerances between journal and bearing corresponding to the quality of finish ; the amount of wear and wear resistance; the proposed scale to measure surface roughness of the British Standards Institute.

TECHNICAL EDUCATION.

How People Learn—A Guide for Teachers in Industry. by E. C. Maxcy. (*Personnel, May, 1943, Vol. 19, No. 6, p. 706*).

Effective industrial training requires not only knowledge of specific job processes but the ability to pass such knowledge on which implies knowledge of how people learn. While a number of important principles of learning have been uncovered in recent years these fundamental rules are frequently violated by teachers and trainers. The author here draws a comprehensive picture of the learning process and outlines the proper teaching procedures to be employed in industrial practice. In addition, he presents a list of important points in teaching and offers helpful suggestions meeting common problems of training.

Education and Training for Engineers. (*The Journal of the Institution of Electrical Engineers, June, 1943, Vol. 90, No. 30, p. 223*).

The education and training and personnel sub-committee.

(1) Introduction.

(2) Recommendations.
Craftsmen and foremen, student apprentices, University trainees, " post-advanced " students.

(3) Outline of the pre-war engineering education and training system for England and Wales. Education. Training.

(4) Essential elements of a satisfactory post-war-system.
Vocation guidance and selection, training of engineers, technical colleges and institutes, university engineering schools, apprenticeship system for professional engineers, post-graduate and post-National Certificate education. Training of craftsmen, craft instruction, practical training, selection and training of foremen.
Selection and training of teachers. Teachers in elementary and secondary schools, teachers in technical schools, University lectures in engineering.

(5) Conclusions.

WELDING, BRAZING, SOLDERING.

Production Applications of Flash Welding. (*R. Milmoe, J.S.A.E. (U.S.A.), Vol. 51, No. 2, February, 1943, p. 73*).

Flash welding is a type of butt weld in which the two parts to be joined are connected to the secondary terminals of a low-voltage high-current transformer, are then brought into close proximity, and the voltage applied. This results in a flashing between the surfaces heating them to the melting point. The flashing is continued for a predetermined period, the parts being moved together as the material burns away. At the end of the flashing period the parts are forced together rapidly and the current is turned off, giving a welded structure of a forged nature.

While extensively used by the automobile industry, this process has not found its way into aircraft construction in the past, because the problems here are somewhat different, and in many cases more exacting.

The advantages of the flashwelded joint over the fusion welded joint include better physical characteristics (100% joint strength), lower weights, cheaper and faster production, no warping as a result of welding, and less operational skill required. SAE 4120 tubing joints welded in the normalized condition with no further heat treatment, exhibit physical characteristics equal to those of the parent material, when tested in static tension.

Most applications have been on tubular and solid round parts, although the process has been used on other types of sections. Parts include the common end-fitting to tube joint, in which the fitting may be a forging or may be machined from bar stock or another piece of tube.

The major points to be considered, in designing aircraft parts for flashwelding, are :

1. Mating surfaces of parts must be of the same shape and approximately the same cross-sectional area.
2. This cross-sectional area must be constant for a sufficient distance back from the joining surfaces to allow all burn-off to take place in such constant-area section.
3. Best design is for the welding faces to be normal to the centreline of the parts, so that the line of travel is paralled to this centreline.

While it is preferable to design new parts especially for the flash-welding process, the author pointed out that it has been found feasible to convert parts which are being arc or gas welded.

(*Communicated by D.S.R. Ministry of Aircraft Production*).

Welding Nickel, Monel and Inconel Clad Steels, by W. G. Theisinger. (*Welding, June, 1943, Vol. XI, No. 7, p. 284*).

It is pointed out that clad steels are readily fabricated by welding provided a suitable welding electrode is used together with the appropriate technique.

A Review of Bronze Welding, by E. Christie. (*Welding, June, 1943, Vol. XI, No. 7, p. 267*).

A comprehensive outline of the process of bronze welding and its various applications. British bombing aircraft have numerous bronze welded joints in their structure and it is admitted that in certain cases it would have been impossible to effect welded joints by any other medium.

Spot-Welding, by T. M. Roberts. (*Aircraft Production, July, 1943, Vol. V, No. 57, p. 338, 9 figs.*).

The developments of condenser-type equipment for the resistance-welding of light alloys by the Bristol Aeroplane Company. The advantages of light alloy spot-welding in the manufacture of all-metal stressed skin aircraft. Condenser-type machine. American practice. Speed. Electrode design. Refrigeration of electrodes. Surface preparation. Comparison of processes. Weld strengths.

WELFARE, SAFETY, ACCIDENTS.

Safety for New Workers, by Gleen M. Daubach. (*The Machinist, London, June 5, 1943, Vol. 87, No. 7, p. 6*).

A plant employing workers with no industrial experience *can* maintain a high safety record. It requires a cooperative safety organization that catches and maintains employees interest.

Rehabilitation and Re-Settlement, by K. G. Fenelon. (*Labour Management, April-May, 1943, Vol. XXV, No. 267, p. 32*).

The necessity of making adequate provision for the rehabilitation and resettlement of injured persons. The chief and continuous aim of a resettlement scheme must be to secure such employment for the greatest possible number of the total group of persons classified as disabled. Rehabilitation. Types of work suited for the disabled. The interim scheme. Emergency hospital scheme. The Tomlinson report. Reconditioning. Special training facilities.

Reasonable Standards for Industrial Canteens in Wartime, by Florence Garrett. (*Industrial Welfare and Personnel Management. May-June, 1943, Vol. XXV, No. 288, p.78*),

S.R. & O., 1943, No. 573 : The Chief Inspector of Factories may say that the canteen is not satisfactory in certain specified respects, including " size, construction, equipment, meals supplied, services rendered therein or otherwise. Canteens in operation. " Better is dinner of herbs, where love is than a stalled ox and hatred therewith." Reasonable staff requirements. Standards required by the Ministry of Food. Prices and costs—within reason. The reasonable customer.

WOODWORKING.

Behaviour of Plywood under Repeated Stresses, by Alvert G. H. Dietz and H. Ginsfelder. (*Transactions of the A.S.M.E., April, 1943, Vol. 65, No. 3, p. 187, 8 figs.*).

Some of the results so far obtained in a continuing programme of research into the behaviour of plywood and laminated wood of both normal and high density. Results on only normal density plywood and laminated wood, bonded with thermosetting phenol-formaldehyde resin and with cold-setting urea-formaldehyde resin, are presented.

SURFACE FINISH

Report of the Research Department of the Institution of Production Engineers, 36 Portman Square, London, W.1.

by DR. GEO. SCHLESINGER, *Director*.

January, 1942

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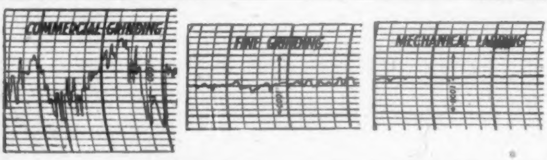
CONTENTS

Principle factors involved. Results of measurements. The influence of the scratching action of the stylus of tracer instruments. (a) Classification of surfaces without measurement. (b) Quantitative photomicrography. Dimension and surface roughness of gauges. The instruments used. Investigation of surface roughness in the U.S.A.



Showing Quality of Surface and Manufacturing Process.

Review from MACHINERY—*England, April* 16, 1942.

The subject of surface finish in relation to dimensional accuracy, fit, lubrication and wear of operational components has been one of the most important questions that have occupied investigators in recent years on both sides of the Atlantic.

One of the chief problems has been the quantative determination of the amount and conditions of surface finish and a unit of roughness.

The results presented in the report make a most important contribution to the development of a technique of basic importance in engineering production, and, in a remarkable table occupying 48 pages, the findings are collected and compared in respect to 500 surfaces of all kinds.

The aims of the research, the chief of which was to replace the loose descriptive methods by a more definite system for measuring surface roughness, appear to have been completely reached.

Review from ENGINEERING—*July* 24, 1942.

The importance of the matter, and, no doubt the very complete basis for a consideration of the subject which is furnished by this report, has led to the appointment of a committee of the British Standards Instutition to consider the formulation of standards.

For the purposes of this investigation the Institution appealed to a wide range of manufacturers of the finer grades of engineering product and obtained typical specimens of finished work from 19 British firms. The most important instruments, both for the measurement of surfaces and for their comparison, were also lent by British and American makers.

Those who have hitherto given little attention to the matter will find the report an admirable guide to the whole subject of surface finish.

Review from AIRCRAFT PRODUCTION, *May* 1942.

Although engineers have realised for some considerable time the importance of the quality of surface finish for both moving and static parts, practical engineering data and technical literature have not hitherto been available for those interested. Consequently the Research Department of the Institution of Production Engineers are to be congratulated on their foresight in making the first thorough investigation of the subject in this country. The results of the experiments have been collected and arranged as practical, useful measuring units in a table giving data describing approximately 500 surfaces of all types. The instruments used for measurement included the most modern tracer and optical apparatus.

Review from MECHANICAL ENGINEERING—*July* 1942 (*American Society of Mechanical Engineers*).

Dr. Schlesinger's book is particularly welcome because it is one of the few books in the English language on the timely subject of surface finish and because it brings together much new and hitherto unpublished information.

The study was undertaken to provide standards for the measurement and rating of metal surfaces and to summarise standard practice in Great Britain as regards the type of finish which is applied to various machine parts by reputable manufacturers.

The tabulation of the results of these measurements in the last 48 pages of the book is one of its most valuable features.

One of the most interesting sections of the book deals with the tolerances and finishes on plug and snap gauges and on gauge blocks. The finish measurements on these tools are quite enlightening.

STEWART WAY, *Research Laboratories, Westinghouse Electric Mfg. Co., East Pittsburgh*

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